

WHAT IS CLAIMED IS:

1. An electron beam exposure apparatus which exposes a substrate with a predetermined pattern using one or a plurality of electron beams, comprising:
 - 5 a substrate stage on which a substrate is mounted;
 - a transfer stage which drives said substrate stage on an X-Y plane; and
 - 10 an electromagnetic actuator which drives said substrate stage in a rotation direction about a Z-axis with respect to said transfer stage.
2. The apparatus according to claim 1, wherein said electromagnetic actuator includes a movable element and a stator, the movable element is fixed on said substrate stage, and the stator is fixed on said transfer stage.
- 15 3. The apparatus according to claim 2, wherein the movable element and the stator are in non-contact to each other.
- 20 4. The apparatus according to claim 3, wherein the movable element comprises a magnet, and the stator comprises a coil.
5. The apparatus according to claim 1, wherein the apparatus further comprises a Z actuator for driving said substrate stage in a Z direction and a tilt frame which is supported on said transfer stage through the Z actuator, and said substrate stage is connected to the

tilt frame.

6. The apparatus according to claim 5, wherein the tilt frame has a connecting member with a degree of freedom in the rotation direction about the Z-axis, and
5 said substrate stage is supported on the tilt frame through the connecting member.

7. The apparatus according to claim 1, further comprising a second electromagnetic actuator arranged between said substrate stage and said transfer stage to
10 drive said substrate stage in at least one of a rotation direction about an X-axis, a rotation direction about a Y-axis, a Z-axis direction, and X-Y direction with respect to the transfer stage.

8. The apparatus according to claim 1, wherein said
15 electromagnetic actuator comprises a plurality of electromagnetic actuators, and the plurality of electromagnetic actuators are combined to drive said substrate stage with six degrees of freedom.

9. The apparatus according to claim 8, wherein each
20 electromagnetic actuator and said substrate are arranged on opposite sides of a center of gravity of said transfer stage in the Z-axis direction.

10. The apparatus according to claim 1, wherein said electromagnetic actuator is covered with an
25 electromagnetic shield.

11. An electron beam exposure apparatus using a plurality of electron beams, comprising:

- a substrate stage on which a substrate is mounted;
- a transfer stage which drives said substrate stage on an X-Y plane; and
- 5 an electromagnetic actuator which drives said substrate stage, in a rotation direction about a Z-axis and a direction perpendicular to an array direction of the plurality of electron beams, with respect to said transfer stage.
- 10 12. The apparatus according to claim 11, wherein the apparatus further comprises a Z actuator for driving said substrate stage in a Z direction and a tilt frame which is supported on said transfer stage through the Z actuator, and said substrate stage is connected to the
- 15 tilt frame.
13. The apparatus according to claim 12, wherein the tilt frame has a connecting member with a degree of freedom in the rotation direction about the Z-axis, and said substrate stage is supported on the tilt frame
- 20 through the connecting member.
14. The apparatus according to claim 13, wherein the tilt frame further comprises a second electromagnetic actuator which is actuated in a direction perpendicular to the array direction of the plurality of electron
- 25 beams.
15. A semiconductor device manufacturing method comprising:

a coating step of coating a substrate with a photosensitive agent;

an exposure step of transferring a pattern onto the substrate coated with the photosensitive agent
5 using an electron beam exposure apparatus as defined in claim 1; and

a development step of developing the photosensitive agent on the substrate, onto which the pattern is transferred in the exposure step.